Forest Health Protection

Northeastern California Shared Services Area
2550 Riverside Drive, Susanville, CA 96130

Sheri L. Smith
Supervisory Entomologist
ssmith@fs.fed.us
530-252-6667

Daniel R. Cluck
Entomologist
dcluck@fs.fed.us
530-252-6431

Special Project Report

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To: District Ranger, American River Ranger District, Tahoe National Forest

Subject: Divide Underburn – Survivability of Fire-Injured Trees (NE-SPR-07-03)

Thank you for allowing Forest Health Protection (FHP) to implement and monitor fire-injured trees in the 1999/2000 Divide Underburns. We have now completed the monitoring of 171 trees (149 ponderosa pine, 11 incense cedar, 11 white fir, 2 sugar pine) in both the spring and fall burn areas.

The Divide underburn area encompasses approximately 1,600 acres and is adjacent to the Foresthill Divide road. The stands are part of the Volcano plantation that was established following a stand replacing fire. The burn units consist of an even-aged sheltered canopy of ponderosa pine with pockets of black oak. The objective of the underburn was to reduce the potential for catastrophic fire by removing the buildup of live and dead understory fuel by 50-75%. In addition, under burning in areas of dense manzanita and deer brush would create a mosaic of different age classes of brush to provide cover and browse for wildlife. Mortality of trees >10 inches DBH was not to exceed 15%. Prior to underburning the units were thinned with a masticating type machine to reduce ladder fuels and the chips were left on site to be burned. The project was conducted through a series of underburns during the spring, fall and winter. (Prescribed fire plan, 10-01-99).

During the initial FHP evaluation (FHP Report # NE00-14, July 17, 2000), it was noted that several trees along the Divide Road had moderate to severe fire-related injuries and the likelihood of their survivability was questionable. The District was considering salvage and wanted to leave all trees that were likely to survive, therefore presenting FHP with an opportunity to further evaluate post-fire survivability of conifers in northeastern CA. In the summer of 2000, FHP sampled and tagged fire-injured trees; evaluating crown and cambium kill, and insect activity. These trees were then monitored for 5 years to document mortality.

Information obtained from this prescribed fire has greatly contributed to our knowledge on the effects of fire-injuries to tree survivability and has also increased our awareness as to the high level of cambium injury that can be expected when burning in stands where heavy surface fuel loadings, consisting mostly of masticated brush chips, are present.

Nearly all of the mortality observed in the Divide Underburn occurred in trees that sustained high levels of crown kill and/or high levels of cambium injury (Tables 2 and 3). While this result is not surprising, what is interesting is that nearly every tree that sustained a cambium kill rating (CKR) of 3 or 4, died regardless of crown condition. For example, 50 out of the 86 trees that had a CKR of 3 or 4 also had greater than 40% remaining live crown. Of these 50 trees, only 7 survived. This suggests that the lower boles of these trees were intensely heated, or "cooked", by the combustion of the masticated material that resulted not only in killing the cambium layer but also injuring the sapwood.

Typically, tree mortality from fire injuries remains high for 2 to 3 years post-fire. The Divide Underburn was different in that nearly all of the mortality occurred within the first year (Table 1). This may be explained by the small average diameter of the sampled trees (11.1" average DBH) and the intensity in which they were burned. Small diameter trees that initially survive a fire but sustain lethal fire injuries, especially to the levels observed during this study, typically fade quicker than large diameter fire-injured trees. This may be due to smaller trees having a lower storage capacity for water and nutrients and a less extensive root system than larger trees. For example, very large trees that sustain lethal fire injuries can remain green up to 5 years post-fire.

It should also be noted that during the course of this study, we observed a rapid re-establishment of the brush understory throughout the plantation. Unfortunately, we were not able to observe the condition of the brush prior to mastication and burning and therefore do not know if the current understory condition is an improvement over the condition that existed prior to treatment and if it currently meets the objectives as described in the burn plan. Therefore, it is recommended that the costs and benefits of burning the masticated material be fully evaluated to see if fuels reduction and other resource goals were met while staying below tree mortality thresholds as outlined in the burn plan. It would also be beneficial to compare the results of mastication and prescribed burning treatments versus mastication treatments alone in terms of meeting resource objectives. In the future, if brush is to be both masticated and burned, it may be necessary to rake some of the chips away from the bases of trees that are to be maintained as residuals or allow enough time between mastication and the underburn to allow the chipped material to decompose enough to alter the flammability and heat intensity.

In conclusion, FHP greatly appreciate the cooperation of District personnel in setting up and completing this study and look forward to working with you again as opportunities arise. Please contact me if you have any questions.

/s/ Danny Cluck

Danny Cluck
NESA Entomologist

Data Summary for the 1999 and 2000 Divide Underburns

Table 1. Total number of trees (all species) and mortality by year.

Season of Rx Burn	# of trees evaluated in 2000 (all live)	2000 Mortality	2001 Mortality	2002 Mortality	2003 Mortality	2004 Mortality	2005 Mortality	Total Mortality
Spring (2000)	86	41	5	1	0	0	0	47
Fall (1999)	85	35	6	0	0	0	0	41
TOTAL	**171**	**76**	**11**	**1**	**0**	**0**	**0**	**88**

Table 2. Number of trees and % survival by percent remaining live crown length.

Remaining Live Crown (%)	# of trees	% survival
0<10	16	0%
10<20	12	8%
20<30	11	18%
30<40	4	25%
40<50	17	59%
50+	109	66%

- The remaining percentage of the original, pre-fire, crown length.

Table 3. Number of trees and % survival by cambium kill rating (CKR).

Cambium Kill Rating	# of trees	% survival
0	50	98%
1	15	87%
2	18	56%
3	12	17%
4	74	8%

- Rating of 0-4 is based on a cambium sample taken in each of four equally spaced directions near ground level. A rating of 0 is equal to no fire injury for any sample and 4 is dead cambium at each sample location.